

Peer Review Comments

By

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On

*Technical Documentation to Support Development of Minimum Flows and Levels for the  
Loxahatchee River and Estuary*

South Florida Water Management District  
15 July 2002 Draft

The South Florida Water Management District (District) must establish Minimum Flows and Levels (MFL) for the Loxahatchee River and Estuary pursuant to 373.042 F.S. A minimum flow is defined as the "... limit at which further withdrawals would be significantly harmful to the water resources or ecology of the area." The minimum level is defined as the "limit at which further withdrawals would be significantly harmful to the water resources of the area." Significant harm is defined as the "...temporary loss of water resource functions which result from a change in surface water or ground water hydrology that take more than 2 years to recover ..." (Rule 40E-8.021[24], FAC). For the Northwest Fork of the Loxahatchee River, significant harm is defined as:

- two or more of the six VEC species are no longer present
- the total number of species present is reduced by about one-third
- the floodplain swamp high canopy is no longer present
- seedlings of the six VEC species are no longer present
- daily mean salinity levels range from 0 to 9 ppt with a mean of 0.97 ppt and a 90<sup>th</sup> percentile limit of 2.9 ppt.

In support of the Loxahatchee River and Estuary MFL effort, the District seeks an objective peer review of any scientific assumption, data and/or modeling results used in the development of technical criteria. Said review will consist of a written review of the *Technical Documentation to Support Development of Minimum Flows and Levels for the Loxahatchee River and Estuary* (15 July 2002 Draft), including:

- answers to general questions provided by District staff
- comments on how successfully the current MFL document addressed the Panel's 2001 Peer Review Final Report
- how well the technical criteria support the proposed MFL.

In addition, the peer review will evaluate specific technical issues as listed in the *Planning & Development Division Request for Expert Assistance* dated 26 July 2002. These issues include:

- use and application of the “Valued Ecosystem Component” approach for establishing the MFL
- the proposed minimum freshwater flow regime proposed for the river system during drought conditions
- completeness of the literature review for the intended purpose
- statistical analysis and interpretation of historical flow, salinity and vegetation data
- methods used to estimate the movement and location of the freshwater-saltwater interface under different flow conditions
- methods used to characterize the vegetation community composition and distribution
- linkage or correlation of flow and /or salinity data to impacts to biological communities
- use and interpretation of the results of a two-dimensional hydrodynamic-salinity model to describe the effect of various freshwater flow regimes for the river and estuary
- the use of historical hydrological and /or ecological data and findings to determine minimum flow criteria for the River
- methods or approaches used to define specific “duration” values that are components of the minimum flow criteria for the River.

District legal and policy decisions further define the scope of the peer review. The review is to consider only the development of the MFL (and not MFL implementation). The review is to accept the water resource functions identified by the District. The review is to accept the District’s opinion that the most critical need is to provide a minimum flow criteria that would protect the Northwest Fork River from significant harm, and that providing said criteria will protect other parts of the Loxahatchee River.

The 15 July 2002 Draft MFL document substantially improves upon the 22 May 2001 Draft. However, my interpretation of the findings suggests a different minimum flow at the Lainhart Dam. The final minimum flow criteria, regardless of its value, should be related to other flows to the Northwest Fork and to other parts of the Loxahatchee River and Estuary.

### **General Questions**

*1. Does the MFL document present a defensible scientific basis for setting minimum flow criteria for the water body? Are the approaches or concepts described in the document scientifically sound based on ‘best available information’?*

The District has done a good job presenting a defensible scientific basis for setting minimum flow criteria for the Wild and Scenic River part of the Northwest Fork of the Loxahatchee River and Estuary. The MFL document describes the River and Estuary in

sufficient detail, including climate, physical features, hydrology, biological and water resources, and nearby land uses. In addition, the MFL document and appendices describe in adequate detail the methods and information used to develop the MFL criteria. For the most part, the approaches and concepts described in the MFL document are scientifically sound and based upon best available information. Nevertheless, finalization of the MFL criteria may benefit from additional consideration of:

- flows from other tributaries
- other factors that might affect vegetation community location and condition
- potential impacts to other parts of the Loxahatchee River and Estuary
- the relationship between 2 ppt salinity and vegetation community location and condition
- soil salinity transects
- the SAVELOX model.

The MFL document describes and discusses in sufficient detail historic, current and anticipated flows over the Lainhart Dam. Also, the document describes the relationship of Lainhart Dam flow to Northwest Fork salinity both empirically and as modeled by the hydrodynamic/salinity model. Collectively, this information supports a reasoned assessment of the Lainhart Dam flow necessary to sustain desired vegetation communities downstream to Cypress Creek. However, beginning with Cypress Creek, nearly 50 percent of the flow to the Northwest Fork comes from tributaries. Therefore, an assessment based upon flow over Lainhart Dam must ensure that absolute and relative flow from other sources is maintained. Alternatively, the assessment must incorporate anticipated changes in flow from these other sources.

Salinity is convincingly the primary factor determining the location and condition of the floodplain swamp and mangrove communities. However, water quantity may be an important factor in determining the location and condition of stream swamp and cypress within the upper reaches of the Northwest Fork and its tributaries. For example, parts of the middle and upper Northwest Fork and Kitching Creek (Segments 2, 3 and 5 of Figure B-3) have consistently been characterized by freshwater, but the vegetation community has changed from cypress to stream swamp. The MFL document should be explicit about whether the goal is cypress, stream swamp or either. If the goal is cypress, then the effect of changes in flow on freshwater vegetation community location and condition should be evaluated.

Legal and policy decisions have limited MFL criteria development to the Northwest Fork of the Loxahatchee River and Estuary. Nevertheless, potential impacts (positive and negative) to other parts of the system should be evaluated and the results described. For example, the Estuary provides numerous resource functions including habitat to protected species (e.g., Johnson's seagrass, *Halophila johnsonii*; West Indian manatee, *Trichechus manatus latirostris*). The District recognizes that a "... viable estuarine ecosystem requires a proper balance of freshwater inflow..." (Chapter 3), but the document fails to discuss if this balance will be achieved and by what means the balance will be evaluated.

The MFL document may give undue weight to 2 ppt salinity. Both the hydrodynamic/salinity model and the SAVELOX model appear to directly equate 2 ppt salinity to salt water, and to indirectly suggest that 2 ppt is threshold for the stream swamp. The former is a useful mechanism for estimating the relative position of fresh water and salt water. However, there is no basis presented for a relationship between 2 ppt and vegetation type. In fact, model results suggest that a mean salinity of 0.15 ppt is related to the occurrence of a healthy stream swamp community. Table 25 (p. 101) also suggests that a healthy stream swamp community requires a mean salinity of < 1 ppt.

Results of soil salinity transects are a welcome addition to the MFL document. Soil salinity may be as important, if not more important, than water salinity in determining the location and condition of the stream swamp community. However, a comparison of the transect locations with plots of historic and existing vegetation (e.g., Figure B-3) suggest that samples were collected in areas that have not experienced changes in vegetation. Presumably, soils in these areas have not experienced significant variation in salinity. An evaluation of soil salinity affects on vegetation community may be enhanced by samples collected at locations subject to changes in vegetation community and exposure to salt water, and locations with stressed stream swamp communities. Said samples would help us understand the cumulative effects of salt exposure, and allow the construct of a relationship between soil salinity and stream swamp condition.

The vegetation survey results and the hydrodynamic/salinity model afforded a tremendous opportunity to evaluate the relationship between vegetation community and river salinity. As the District recognizes, vegetation could be responding to certain salinity levels or salinity ranges, the duration of a particular salinity event, the frequency of a particular salinity event, or other factors. SAVELOX manages these potentially confounding variables by creating a new variable  $D_s/D_b$  (duration of exposure/time between exposures) as a surrogate for long-term salinity conditions. This is an admirable attempt to integrate the various salinity factors. Our understanding of the relationship between vegetation community and salinity may also benefit from an examination the relationship between vegetation community and individual salinity factors, and combinations of salinity factors. If this has not already been accomplished, the District might consider the use of step-wise regression analysis.

*2. Are the proposed criteria logically supported by 'best available information' presented in the main body of the document? What additions, deletions or changes are recommended by the Expert to enhance the validity of the document?*

The District has demonstrated that a healthy stream swamp community exists at River Mile (RM) 10.2. RM 10.2 has a mean salinity of 0.15 ppt. Salinity intrusion events above 1 ppt and 30 days duration occur once every 1.6 years, events above 2 ppt and 22 days duration occur once every 5.9 years, and events above 3 ppt occur once every 30 years. The District intends to reproduce the RM 10.2 salinity regime at RM 9.2.

The proposed MFL criteria is based on a desire to prevent the salinity at RM 9.2 from exceeding 2 ppt for any longer than has occurred within the healthy swamp community (i.e., no more than 20 days duration more often than once every six years). The document then concludes that Table 40 can be used to select a flow over Lainhart

Dam of 35 cfs to maintain mean daily salinity below 2 ppt at RM 9.2. However, a flow of 35 ppt in Table 40 corresponds to  $\leq 2$  ppt for 30 days once every four years, and not a mean salinity of 0.15 ppt and the duration and frequency parameters for RM 10.2 (see above) intended to be mimicked for RM 9.2.

The MFL criteria is also predicated on the belief that vegetation at RM 10.2 is healthy, vegetation at RM 9.2 has suffered significant harm, and that vegetation between these two stations has been harmed (but not significantly). However, the significant harm criteria applied to the vegetation between RM 9.2 and RM 10.2 suggests that much of this area has also suffered significant harm. Three VEC species are missing at RM 9.3 and two VEC species are missing at RM 9.7 (one species is missing at RM 9.9). Also, seedlings for four of the six VEC species are missing from the community between RM 9.2 and RM 10.2. Perhaps the definition of significant harm should be clarified to indicate whether all conditions must be satisfied, or whether failure to satisfy one of the criteria is sufficient to designate significant harm.

Significant harm for the vegetation community between RM 9.2 and RM 10.2 can be avoided by reproducing salinity conditions at RM 10.2. According to Table 37, a flow of 50 cfs at the Lainhart Dam will produce a mean salinity of 0.14 ppt at RM 10.2. A flow of 100 cfs at the Lainhart Dam will produce a comparable salinity condition at RM 9.2, and by extension at intervening locations. Flows less than 100 cfs will likely eliminate mature individuals or seedlings of the six VEC species, and thus impart significant harm.

*3. Are there other technical approaches to setting the criteria that should be considered? Is there available information that has not been considered by the authors? (If so, please identify specific technical alternatives to setting the MFLs and the data available to validate the alternative approach).*

The District has expended considerable effort in investigating and evaluating technical approaches for setting the criteria. No other technical approaches are recommended, other than those previously noted.

*4. Does the current draft MFL document adequately address the comments provided by the 2001 Peer Review Panel Final Report?*

The Panel's task is not to judge the adequacy of the District's response to our 2001 Report, but to provide advice and allow the District to judge the value of said advice. That being said, the current draft MFL document responds to some, but not all, of the comments in the 2001 Peer Review Panel Final Report. The readability of the text and figures has been improved, although careful proofreading of both is still required. Regarding organizational recommendations, the document has been reorganized to emphasize the technical analysis and modeling of salinity conditions. The document has not been reorganized to provide a section on the expected impact of flow modification on the Loxahatchee River and Estuary. Nor does the document provide MFL recommendations for the North Fork, Southwest Fork or the Estuary.

So too, the current document responds to only some of the Panel's technical comments. For example, the current document addresses the question of whether mangroves continue to encroach on the stream swamp community, inflow data for the

entire Estuary, and the inadequacy of information relating cypress condition to salinity. Conversely, the current document fails to address the Panel's comments about anticipated regional growth and development, feasibility of proposed actions, the inadequacy of a linear approach to flow and discharge relationships, and a lag between Lainhart Dam flow data and downstream salinity.

### **Specific Technical Issues**

The appropriateness of:

*use and application of the "Valued Ecosystem Component" approach for establishing the MFL*

The VEC approach has merit, and can be a valuable tool for management decision-making when the value of the selected ecosystem component is clearly established, and the relationship between the selected ecosystem component and other ecosystem components is clearly defined. The VEC approach for the Loxahatchee River and Estuary MFL was improved in this draft by replacing cypress with six stream swamp tree species. In this manner, the relationship between the VEC and the stream swamp community is more clearly defined. However, the use of six stream swamp tree species has not clarified the relationship between the VEC and other Loxahatchee River and Estuary ecosystem components. Of particular concern is the absence of an identifiable relationship with estuary resource functions.

*the proposed minimum freshwater flow regime proposed for the river system during drought conditions*

As discussed above, the proposed minimum freshwater flow regime does not demonstrably protect the river system during drought. The proposed flow would seem to maintain stress and/or deteriorating conditions in the stream swamp community, and the effects on the remainder of the Loxahatchee River and Estuary are indeterminate.

*completeness of the literature review for the intended purpose*

The literature review is reasonably complete for the intended purpose, if the purpose is solely the protection of the stream swamp community in the upper reaches of the Northwest Fork. The literature review should be expanded if it is also the purpose of the MFL criteria to protect the Loxahatchee River Estuary.

*statistical analysis and interpretation of historical flow, salinity and vegetation data*

For the most part, the statistical analyses of historical flow, salinity and vegetation data are appropriate. The District's efforts indicate due diligence, and a willingness to be innovative. As noted above, the hydrodynamic/salinity and SAVELOX models include an assumption that 2ppt salinity is a critical threshold for the stream swamp community. This assumption should be verified or removed.

Also as noted above, my interpretation of the data have led to different conclusions. Specifically, I note the potential influence of water quantity in determining the nature of the stream swamp community, and a need for a minimum average flow of about 100 cfs over the Lainhart Dam to maintain a stream swamp community at RM 9.2.

*methods used to estimate the movement and location of the freshwater-saltwater interface under different flow conditions*

The methods used to estimate the movement and location of the freshwater-saltwater interface under different flow conditions are appropriate and reasonable for estimating salinity conditions along the Northwest Fork of the Loxahatchee River.

*methods used to characterize the vegetation community composition and distribution*

The methods used to characterize the vegetation community composition and distribution are appropriate and reasonable.

*linkage or correlation of flow and /or salinity data to impacts to biological communities*

The methods used to correlate flow and/or salinity data to impacts are appropriate except where noted. Soil salinity samples should be collected at intervening stations along the Northwest Fork, and the data used to examine the relationship between soil salinity and vegetation type. The 2 ppt salinity threshold implicit in the models should be verified or eliminated.

*use and interpretation of the results of a two-dimensional hydrodynamic-salinity model to describe the effect of various freshwater flow regimes for the river and estuary*

The two-dimensional hydrodynamic-salinity model is a useful device to describe the effect of various freshwater flow regimes for the river and estuary. The model was put to good use, except when a 2 ppt salinity value was assumed to have significance for the vegetation community.

*the use of historical hydrological and /or ecological data and findings to determine minimum flow criteria for the River*

The use of historical hydrological and/or ecological data and findings were used appropriately to determine minimum flow criteria for the Northwest Fork, although the findings are subject to interpretation (see above). Historical hydrological and/or ecological data should be applied to a minimum flow criteria for other parts of the Loxahatchee River and Estuary, especially the latter.

*methods or approaches used to define specific “duration” values that are components of the minimum flow criteria for the River*

Defining specific duration values for the minimum flow criteria is a difficult task. The approach taken by the District is innovative and illustrates a determination to make the best decision possible. Undoubtedly, the duration estimates derived from the analyses are educated guesses. Nevertheless, the criteria is better served with their inclusion than without.

## **Conclusions**

The District has demonstrated considerable diligence in obtaining and analyzing hydrological, salinity and vegetation data for the Northwest Fork of the Loxahatchee River. The hydrodynamic/salinity model and the SAVELOX model are appropriate and reasonable approaches to defining ecosystem component relationships and deriving a

minimum flow criteria. As noted above, we differ in our final interpretation of an appropriate minimum flow criteria. The minimum flows and levels process for the Loxahatchee River and Estuary may benefit from review of data interpretation. Also, the minimum flow over the Lainhart Dam must be linked with flows from other tributaries of the Northwest Fork.

Focus on the upper reaches of the Northwest Fork was a policy decision, and therefore beyond the purview of the expert review. Nevertheless, I urge the District to more fully evaluate the consequences of any final minimum flow over the Lainhart Dam on other parts of the Loxahatchee River and Estuary.

### **Recommendations**

- Establish with minimum flow criteria for other tributaries of the Northwest Fork, and connect these criteria with the minimum flow criteria for the Lainhart Dam.
- Determine the effect of water quantity on type of freshwater vegetation community in the upper reaches of the Northwest Fork.
- Evaluate potential impacts to other parts of the Loxahatchee River and Estuary from the minimum flow criteria for the Lainhart Dam.
- Verify the relationship between 2 ppt salinity and vegetation community or eliminate the assumption from the models.
- Conduct soil salinity sampling at intervening locations and re-evaluate the relationship between soil salinity and vegetation community.
- Evaluate the relationship between individual and combined salinity variables and vegetation community.
- Establish a monitoring program to determine the effectiveness of the final minimum flow criteria.